S.E. E&T sem IV

IS June 2010

E W T.

Con. 3817–10. (REVISED COURSE) AN–3490

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** out of remaining **six**.
(3) Assumptions made should be **clearly** stated.
(4) Assume data wherever **required** with **justifications**.
(5) **Figures** to the **right** indicate **full** marks.
(6) Illustrate answers with **sketches** wherever **required**.
(7) Use **legible** handwriting. Use a **blue/black** ink pen to write answers.
(8) **Bold** letters indicate vector **quantities**.

1. (a) What is the relation between electric potential and electric field intensity? What do you understand by "conservative field"? (03+01)

(b) What is scalar and vector magnetic potential? Give their expression and significance along with their units. (03+02)

(c) What is the discrepancy in Ampere's Law? How was it removed by Maxwell? (02+03)

(d) State Gauss's law for electrostatic fields. Using Gauss's law, derive expression for intensity due to an infinite line charge. (02+04)

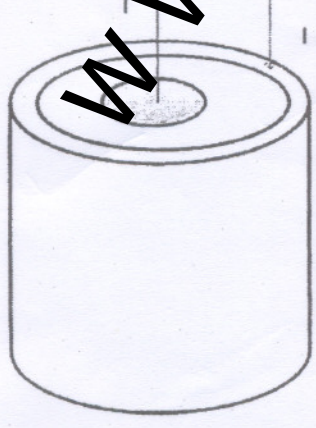
2. (a) Develop an expression for **E** due to a uniform charge density ρ_s on an infinite sheet. (08)

(b) A current filament of 5 amp in y-direction is parallel to the y-axis at x=2, z=-2. Find **H** at the origin. (06)

(c) Derive expression for the potential energy stored in a static electric field. (06)

3 (a) A uniform line charge with $\rho_l = 50\mu C/m$ lies along the x-axis. What flux per unit length Ψ/L, crosses the portion of the z=-3 m plane bounded by $y = \pm 2$ m? (08)

(b) Currents in the inner and outer conductors of figure (1) are uniformly distributed over cross-section. Radius of inner conductor is 'a' and the outer radii are 'b' and 'c' respectively. Find **H** everywhere due to the cable. (12)



[TURN OVER

4. (a) If the zero potential reference is at r=10 m, and a point charge Q=0.5 nC is at the origin, find the potentials at r=5 m, and r=15 m. At what radius is the potential the same in magnitude as that at r=5 m but opposite in sign? (06+02)

(b) Verify Stoke's theorem for portion of a sphere $r = 4,\ 0 \le \theta \le 0.1\pi, 0 \le \phi \le 0.2\pi$; (06+06)

$$\vec{H} = 6r\sin\phi\,\hat{r} + 18r\sin\theta\cos\phi\,\hat{\phi}.$$

5. (a) In cylindrical coordinates, ρ=5mm and ρ=25mm have voltages of zero and Vo respectively. If E= -8.28 $\hat{\rho}$ KV/m at ρ=15 mm, find V_o and the charge density on the outer conductor using Laplace's equation. (06+04)

(b) State and explain Faraday-Lenz's law. Obtain point form and integral form of Maxwell's equation for induced motional and transformer emf. (04+03+03)

6. (a) Derive general wave equations for E and H fields. Give solution to the wave equation in perfect dielectric for a wave travelling in z-direction, which has only x-component of E-field. (10)

(b) A uniform plane wave propagates in a medium with $\varepsilon_r = 4, \sigma = 0, \mu_r = 1$. The E-field has only x-component which is sinusoidal with a frequency of 100 MHz and has maximum value of 0.1 mV/m at t=0, z=1/8. Find instantaneous expression for E(z,t) and H(z,t). Also find the location where Ex is positive maximum at t= 10 ns. (06+02+02)

7. Write short notes on <u>any two</u>:— (20)

a) Boundary conditions in Electrostatics and Magnetostatics

b) Method of images

c) Maxwell's equations for steady and time varying fields.